Bayes or Bust: A Critical Examination of Bayesian Conformation Theory

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It has become an increasingly common grumble in the philosophy of science community, that the best books are all being written by the same person. In his 1986 book A Primer on Determinism, Earman cleaned up a whole morass of puzzles and problems concerning the resources of physical theories from classical mechanics to general relativity to express a reasonable notion of determinism. Then in his 1989 book World Enough and Space-Time, he did the same for absolute versus relational theories of space and time. Now in his latest offering Earman tackles with relentless thoroughness, but with a delightfully light-hearted and witty style, the vexatious problems of confirmation theory, how empirical evidence bears on our acceptance of or belief in scientific hypotheses and theories. He does this in the context of arguments for and against the currently popular Bayesian approach to these matters. The basic idea here is to provide a rational dynamics of belief in terms of revising a prior degree of belief in a scientific theory measured by a number between zero and one, a subjective probability, to a new posterior degree of belief in the light of empirical evidence, by conditionalizing the probability on the evidence. All sorts of questions arise. Do degrees of belief in fact conform to the probability calculus, or is this a normative proposal, telling us how our beliefs should rationally cohere? Again, even if we grant that our beliefs at any one time must conform to the laws of probability, why should revision of these beliefs diachronically across time be expressed in terms of a conditional probability evaluated synchronically at a time?

After a preliminary historical chapter detailing the problem that exercised the Reverend Thomas Bayes in his original 1736 work entitled 'An Essay Towards Solving a Problem in the Doctrine of Chaos', Earman plunges into the technicalities of modern Bayesianism, and assesses very fairly the answers provided in the literature to the questions I have already mentioned. He goes on to explain how Bayesians deal rather effectively with many of the famous paradoxes of confirmation theory, for example of saying exactly why observing a white shoe a clear instance of a non-black thing which is not a raven, should not count for much in asessing the hypothesis that all ravens are black.

Earman continues with some of the standard challenges. Is it technically possible for universal generalisations to have non-zero priors? In spite of argument to the contrary, this is actually quite easy to achieve, but is it rational to make such assignments? This raises the whole question of the status of the prior degree of belief, conditionalised on our background knowledge before specific evidence comes in. The Bayesians are fond of citing various technical results establishing that in the long run the priors don't matter, their effect will be washed out by the evidence, with a rational convergence of opinion justifying an objective standard of rationality in the scientific community for believing scientific theories. Earman is at his best in disentangling the details of these proofs, and shows very convincingly that they just don't do the job required. The best one can say, according to Earman, is that the priors are where prejudice and irrationality inevitably arise, even if we allow that the revisions in our degrees of belief can be rationally justified. It would be nice if we could be better, but maybe that is all we can and should expect, to disentangle the absolute magnitudes of our degrees of belief from the rationality of how these degrees of belief change in relative terms.

Another big problem for the Bayesians is the question of how evidence already known can support a newly proposed theory. For example most physicists would claim that the motion of the perihelion of Mercury supports general relativity in spite of the fact that this observational fact was well known before Einstein proposed his theory. But at first blush the Bayesians cannot explain this simple and obvious fact about what confirmed what in relativity theory. Earman discusses all the proposed solutions to this problem, but at the end of the day he regards it as a major stumbling block for Bayesianism.

In summary the book is a very fair assessment of the current status of Bayesian confirmation theory. I recommend it very highly to anyone wanting a sensible guide to this difficult terrain.